quality of working life

JOB DESIGN AND SOCIOTECHNICAL SYSTEMS

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FOREWORD

The Quality of Working Life (QWL) series was inaugurated by Labour Canada in September 1978 with the publication of "QWL: The Idea and its Application". A number of additional titles in the series have been published since that time and others are contemplated. The booklets which are prepared by Labour Canada in conjunction with experts in the field are intended to provide the reader with information on various aspects of Quality of Working Life. Readers desiring a more comprehensive understanding of the subject matter in each case may wish to consult some of the books, papers and articles listed in the appendix.

One of the major components in improving QWL and organizational effectiveness is the design or redesign of jobs and of the work organization. Sociotechnical analysis has become a well-accepted approach to accomplishing this end. The current booklet is an attempt to provide the interested reader with an overview of both job design and sociotechnical analysis which hopefully will be of assistance to those concerned with the introduction of quality of working life changes within their organizations.

In their treatment of the subject matter, the authors have tried to be as objective and neutral as possible realizing that employers, employees and unions may perceive jobs and the nature and purpose of work organizations from quite different perspectives. They will feel that their efforts have been successful if the booklet proves helpful to those managers, union officials and employees who are interested in exploring approaches that might assist work organizations in becoming more effective and more responsive to the needs and aspirations of a changing society.

T.M. Eberlee
Deputy Minister
Labour Canada

JOB DESIGN AND SOCIOTECHNICAL SYSTEMS

"Quality of Working Life" has become an increasingly familiar term that means a lot of different things to different people. In its most general sense "QWL" refers to the attitudes of people to their jobs and to their total work environment. In more concrete terms it refers to a wide range of innovations taking place in the workplace in response to a changing and "turbulent" environment.

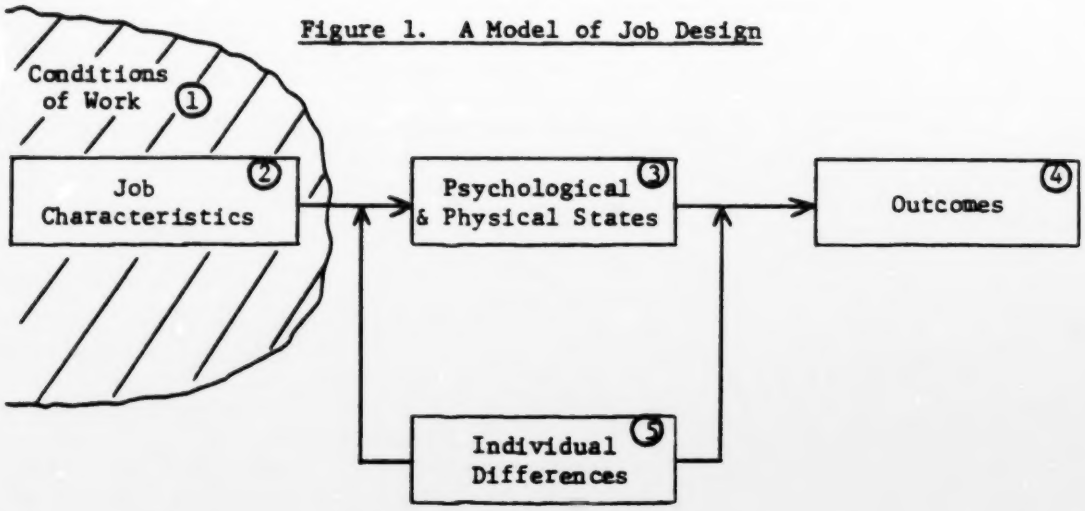
This booklet addresses one set of innovations which focus on the organization and management of work itself.[1] Job design represents an approach to design specific jobs to make them more interesting and rewarding for the individual job holder and more productive for the organization. Sociotechnical systems represents a more comprehensive approach to designing total work systems as well as individual jobs. "Socio" refers to the people involved in the jobs, their roles and responsibilities, their individual behaviour and their interactions as a social system. "Technical" refers to the particular task they must carry out and the technology (tools, equipment, facilities, processes) they utilize to do so, both as individuals and as a work group.

This booklet is an attempt to bring together, in a fairly fundamental way, some of the pertinent thinking and experience on both job design and sociotechnical systems, as well as to provide an understanding of their roots and of their application in modern organizations. It is not meant to be a handbook for practitioners or students of organizations, but rather an introduction to what is possible for those who wish to improve the quality of their own work organization. The references provided will assist those who wish to explore, in greater detail, some of the ideas presented herein.

JOB DESIGN

If we want to set about redesigning jobs to make them more satisfying as well as more productive, we should know something about what constitutes a good job. The list of properties related to a "good job" is an extensive one. One way to understand that list is to divide it into several categories. (1) Those that refer to the situation that surrounds the job we will refer to as the conditions of work. (2) Those that refer to the nature and content of the job or work itself we will refer to as job characteristics. (3) The way in which a person responds to the nature and content of the job determines that person's psychological and physical state. (4) That state, in turn, affects several outputs or outcomes. Figure 1 illustrates these four factors plus a fifth called individual differences, which we will explain shortly.2

Figure 1. A Model of Job Design



(1) The conditions of work include, but go beyond, a characteristic package of fringe benefits. It consists of items such as: fair and adequate pay, job security, job safety, basic health protection, adequate working conditions in terms of such items as cleanliness, room temperature and humidity, freedom from high noise levels and noxious odours, equality and due process in treatment by peers and superiors, and the opportunity for some human interaction during the working day.

(2) The characteristics of a good job have been variously described by social scientists. Dr. Eric Trist has outlined one set of factors that most advocates of job design would accept.[3] The factors are: a job should be reasonably demanding in terms other than sheer endurance; a job should provide a minimum of variety; a person should be able to learn on the job on a continuing basis; a job should include some areas of decisionmaking that a person calls his or her own (autonomy); there should be some degree of social support and recognition in the workplace, from both fellow workers and bosses; people should be able to relate the work that they do and what they produce to their social lives (meaningfulness); people should be able to feel that their jobs will lead to desirable futures. Other lists of job characteristics include factors such as: a job should be perceived as a complete task, people should have access to good feedback data about how they are performing. Still other job characteristics refer to how a job interacts and is interdependent with other jobs.[4] (Appendix I is another list of job characteristics.)

(3) Psychological and Physical States refer to several things. Psychological State refers to an attitude within the individual; in other words, to the willingness and desire felt by the person in the job to carry out the job activities. That willingness and desire is derived from items such as the sense of responsibility experienced by the person, how meaningful the work is perceived to be, a felt sense that the person always knows how he or she is performing on the job because good feedback is available, plus the challenge that the work itself appears to offer.[5] It also includes the mental strain and stress as well as the

exhilaration and excitement that certain jobs bring on. Physical state refers to aches, pains and sore muscles that a hard job develops or that a badly designed physical setting creates. For example, poor seating that leads to neck and shoulder pain.

(4) Psychological and physical states affect outcomes. Two types of outcomes are generally identified: one relating to job satisfaction/dissatisfaction measures and the other to measures of performance. The satisfaction/dissatisfaction measures are generalizable across most jobs (and most organizations) and include well-known items such as self-esteem, internal motivation and attitudes and feelings about the potential of the job for personal growth. Absenteeism and turnover are also general outcomes. Sometimes they are considered a consequence of satisfaction. Others see them as more closely related to performance outcomes.

The performance measures tend to relate more specifically to the particular job and situation in question. Typical work performance measures might include: number of items produced, number of customers served, measures of quality, percentage of errors or returns, time to repair or rework, etc. Measurement is often straightforward, but comparison across jobs is difficult because of the uniqueness of each job. In other instances, the particular job is highly interdependent with others and a single individual's work performance is difficult to measure. For example, it is difficult to separate out the work of a single mechanic who is part of a team maintaining complex equipment. In general, distinctions tend to be drawn between the quality and quantity aspects of work performance.

(5) Individual Differences are the fifth component in Figure 1. They influence the relationship from job characteristics to psychological and physical states as well as from the latter to the outcomes. Different people respond in different ways (psychologically and physically) to different job characteristics and conditions of work. Furthermore, people differ in the extent to which different combinations of attitudes and physical well-being will lead to particular outcomes.

Individual differences must enter into any effort to redesign jobs. Some people are high achievers. Others have a low need for achievement. Some individuals are ambitious and have an internal desire to grow on the job. Others are less motivated by the workplace. Some people enjoy having their work lives directed by others while some prefer to take their own initiatives. Some individuals work well with ambiguity. They view conflict as a challenge. For others, ambiguity and conflict are sources of stress. Among different individuals, some or all of these different characteristics may apply. It becomes quickly evident that designing jobs to lead to particular performance and satisfaction outcomes is not a simple task.

An Example of Job Enrichment[6]

In 1973 the Toronto Office of the Prudential Insurance Company of America began a program of job enrichment to combat job

dissatisfaction. Their goal was to make each job more interesting, to give workers more decisionmaking authority, to provide them with direct feedback from the customers they served, and to try to make each job a complete one, a whole task. The job enrichment program took place in 12 different sections and in most of them the employees carried out a total job which ranged from filing their own papers to actually making direct contact with customers. One employee explained, "We now follow a case right through from the time its reported to the time the cheque goes out. It gives you more of a sense of responsibility. Now, at the end of the day you feel like you've accomplished a day's work; before you felt like you were just pushing paper".

In evaluating the effects of the job enrichment program, some of the following outcomes were identified: employees who previously felt they had reached their highest potential had progressed to even higher levels of work and salary; more employees had moved to top salary levels without an overall increase in salary costs; employees were more productive so fewer were needed; management was less involved in day-to-day problems and more able to concentrate on planning and on performance evaluation; morale was higher; employees were willing to accept more responsibility; employee attitudes to work and job satisfaction had improved; turnover and training costs had decreased; absenteeism had been reduced. One of the employees added her own comments, "Now I have a sense of independence. To a certain extent I can make my own decisions, without running to a supervisor. I used to be told what to do and I wasn't supposed to ask why. Now I <u>know</u> why, and I do my work better because of it."

SOCIOTECHNICAL SYSTEMS

The early work in the development of sociotechnical systems concepts came from studies into the changes that technology had created in the coal mines in Britain.[7] Coal-mining had been a manual operation performed by small independent teams of miners. With the introduction of the longwall method of coal-mining where undercutting equipment is used to prepare the coal face, along with more powerful explosives and conveyor belts to transport the coal, coal-mining became a much more technologically sophisticated undertaking. In redesigning their organizations to take advantage of the technological innovations, many of the mine owners and managers moved in the direction of getting the highest possible production from the new technology. They paid very little attention to the social requirements of the redesigned work groups. Production improvements were well below what they should have been and were accompanied by significant increases in job dissatisfaction.

However, the researchers also found that not all the mine managers implemented the technological innovations in the same manner. In some British coal fields, the best technological designs were compromised in favour of more concern for the social structure of the work group. In these "composite" systems, the coal face was redesigned

so that the miners worked in self-managing groups and were paid as a group for the level of production they achieved. What became apparent to the researchers was that different combinations of social and technical arrangements resulted in different combinations of, on the one hand, production and on the other, job and social satisfaction. The resulting job and social satisfaction of the miners more than compensated for what was less than the best technological design. The combined sociotechnical system outperformed, on both performance and satisfaction dimensions, most of the systems that had been designed purely on a technological basis.

The conclusion of the researchers was that in high performing work groups, the interdependence of the social systems and the technological systems was taken into account. Within this conceptual framework there was also room to account for many of the other variables that could affect a particular situation. For example, variations in the geology of the coal face has a significant impact on output. As a result, the sociotechnical arrangement that suited one coal mine could be quite inappropriate in another. In like manner, the experience of the people in a particular mine, the state to which the coal mine had advanced in introducing technological improvements, the social system "on top", and a host of other variables could each affect the choice of sociotechnical arrangement for that particular situation. It suggested to the researchers that context was also a critical aspect of organizational design.

The British coal mine research led to two basic principles of sociotechnical systems theory. First, there is a best combination or joint optimization of the social and technical components of a system with respect to its environment(s). Second, a system is recognized as being open to continuous influence by the culture and values of those same environments. It follows, then, that technology should not dominate in good sociotechnical systems design. The social component needs equal consideration. Similarly, the social design must not ignore the technology of the situation.

Too often, organizational designers have accepted the constraints of a "technological imperative". In other words, they have shaped the social system to accommodate the apparent inflexibility of the technical system. However, technology is often more flexible than it first appears. More important, it is the social and production performance of the total system that must be optimized and not that of the technical system alone. This can quite conceivably result in a very effective total system with less than the best performance in either the technological component or the social one, or both. The coal-mining example described above illustrates how maximizing technical efficiency was less effective, along both social and performance dimensions, than a total sociotechnical organizational arrangement. A similar argument can be mounted against maximizing the social component alone.

There are still other important attributes of sociotechnical systems. Such systems are usually designed to include mechanisms that

invite participation of the organization members in problem solving situations and in decisionmaking. As a result, they tend toward flat structures with minimal status differentials.

For would-be sociotechnical systems designers there are other suggested guidelines: design so as to specify only the initial critical dimensions; use an "action research" approach, i.e., let the data from the process itself influence subsequent design decisions; form design teams that are themselves in keeping with sociotechnical perspectives, i.e., that use participative approaches and that have appropriate representation from the people who will be affected by and involved with the new organization.[8]

Sociotechnical design usually results in a structure based on self-managing work teams, as responsibility for local control is delegated to the level where knowledge resides to make local level decisions. With responsibility transferred to team members, the supervisory role changes. Supervisors become more involved with managing the interface between the work team and the organization and do more in the way of coaching and guiding and less in the way of directing as the team takes on many of its own administrative activities. Some sociotechnical system designs eliminate supervisors altogether. This is a very difficult, sensitive and contentious design problem. We will raise it again later in this booklet.

An Example of New Plant Design[9]

Shell Canada has designed and is starting up a $230 million chemical plant in Sarnia, Ontario. After several years of extensive study of a variety of quality of work life projects in Europe and the U.S.A., Shell chose an innovative approach to work design based on sociotechnical principles and employee participation. The design process was a lengthy one because it tried to leave opportunities for those who would become members of the work teams to influence the design as much as possible.

The design team and the union worked co-operatively. The collective bargaining agreement is a brief four-page document rather than the usual detailed agreement replete with legal language and elaborate controls. The plant has been designed with normal status symbols removed: no reserved parking, no separate executive cafeteria, etc. Supervisors have been replaced by team co-ordinators whose functions are, literally, co-ordination and coaching. According to the union representative, turnover is much lower than it would normally be in a new plant with a conventional design.

In the plant layout, computers and quality control system output data have been located adjacent to where the actual work is done to ensure that individuals and work teams have the needed information to make correct decisions and take appropriate action.

The plant comprises six basic work teams, each composed of 18 people with a variety of skills. Team members have been selected for

interpersonal competence and this has been augmented with team training around team discipline, multiskill progression and the basic philosophy of the design. The progression payment system has been designed to reward team members according to the number of skills each has mastered.

The Shell Sarnia statement of philosophy sets out its beliefs that: "employees are responsible; individuals are capable of making decisions; and groups can work together effectively...with minimum supervision". It goes on to express other aspects of the design that illustrate a sociotechnical basis:

- employees should be permitted to grow, advance, and contribute to their fullest potential;
- compensation should be on a basis of knowledge;
- communication should be open;
- information flow should expedite action;
- whole jobs should be designed;
- feedback should be designed to maximize individual self-control;
- artificial departmental or functional barriers should be eliminated;
- time on shift should be minimized;
- climate should encourage problem-solving, learning from errors rather than punishing the errant;
- status differentiation should be minimized.

A FRAMEWORK FOR WORK DESIGN

New and Old Design; High and Low Technology

Our earlier examples of job enrichment and a new plant design raise several questions. Is the work design process the same in insurance companies as it is in oil refineries? In other words, is it easier to redesign in some technologies than in others? How different is the redesign of an ongoing operation from the design of a new plant or a new office situation? Are there some who benefit from redesign and some who lose or does everyone gain? Is the redesign effort directed at improving performance or is improved employee satisfaction the primary objective? How long does it take? What are the attitudes of unions to the redesign of jobs and organizational arrangements? Is job and organization design best accomplished in a situation where performance and job satisfaction are good or is it an approach to use in situations of poor performance and low job satisfaction? We will address these and other issues in the pages that follow.

We can begin to answer these questions by referring to a research study in an Eastern Canadian pulp and paper company and using it as a way to work with the concept of sociotechnical systems.[10] About half of the wood delivered to the company's mills by the woodlands division of the company was cut by teams operating mechanical harvesting equipment. All such teams were similarly organized, all had the same equipment and the same complement of operators and mechanics, both in numbers and years of experience. Yet despite the fact that tree size and terrain were taken into consideration, some of the teams consistently cut over 1 100 cords of wood per week while others rarely exceeded 600.

One of the most experienced of the mechanical harvester supervisors in the company explained the differences in production as follows, "Layout and trained people or, in other words, the efficiency part of it can give you up to 800 cords per week. After that, the group effort will make the difference".

If we elaborate his comments, he was saying that if the work team was cutting in good wood, and the equipment was functioning well, and the operators and mechanics were well trained, and supervision was providing good direction, then it was possible to get a team to cut 800 cords of wood per week. But if you wanted to do better than that, then you also had to pay attention to how the team was working, that is, the entire social system in which the team functioned. This might include how the mechanics and operators worked together, how individuals helped and covered for each other, the shift rotation pattern, how responsibilities were divided, the kind of training and coaching given, whether the reward system was congruent with the work goals, etc. Concentrating on technical efficiency alone could take the team a long way, but outstanding performance, the kind that left operators and mechanics with a sense of accomplishment at the end of the day, demanded <u>joint</u> consideration of the social and technical aspects.

Our understanding about how people work is still quite elementary. It may be that there are situations where the work to be done is so well understood that the best output can be achieved by considering the technical components alone. In other words, no account need be taken of the social components. Unfortunately, in most such situations, people would end up being treated as extensions of the technical equipment, as appendages to the machines. We have enough experience with assembly line operations to know that systems so designed eventually break down.

Figure 2 is a way to think about job design and sociotechnical systems design. It is a loose framework which allows us to classify some issues and to respond to some of the questions raised earlier. The horizontal axis represents increasing amounts of freedom available to the system designers with respect to the technology and technical systems of the particular organization. The vertical axis represents the extent to which the social aspects of the system can be affected by the designers.

First, consider the horizontal or technical axis in the case of a totally new plant. The designers may have considerable freedom to arrange the technology and the technical system to some preferred organizational arrangement. Alternatively, they may find that because there are necessary technological sequences or technical procedures that must be followed, the freedom they have to rearrange the workflow is very limited. Now consider that same technical axis in the case of existing organizations. There are situations where the designers may have relatively little freedom to affect the technology, as in an automobile assembly line. However, if the technological investment is not too high, as might be the case in an insurance company administrative office, they may actually have even more freedom than, for example, the designers of a totally new oil refinery.

Turn now to the other axis of Figure 2. Discretion to change the social system may be constrained because the unit in question is but one part of a larger system. The designers may have no authority to change the personnel practices and reward systems because they apply to all the employees in the larger system. Furthermore, some organization policies and practices don't fit too well with work redesigns that call for more collaboration, participation or team self-regulation than has been customary. For example, in enriched jobs, employees may need technical training and problem-solving training that the organization doesn't normally provide. Or the compensation systems may be geared for individuals and for merit and not for team incentives or profit sharing or productivity bonuses. Supervisory practices, for example,may severely constrain a supervisor from delegating some responsibilities to teams, responsibilities that new work designs might consider essential for success.

Even where the designers possess the authority to make such changes, they may have to work with a unionized unit whose own discretion is limited either by its membership in a larger national body or by a collectively negotiated agreement. Alternatively, the designers may be able to negotiate separate terms and conditions for the particular work unit in question with the union and/or the organization as a whole. This was the case in the earlier mentioned Shell Oil plant design in Sarnia. The designers may also find themselves constrained because a history of authoritarian management has established norms which limit the capacity of even willing employees to participate and become actively involved in new or redesign efforts. At the other extreme, the designers may have the freedom to start anew and select employees who have good collaborative and social skills.

In effect, the discretion of the designers can vary considerably across old and new plant designs and in situations of high and low technology. We will illustrate these points by referring to specific examples in each of the cells of Figure 2.

We must introduce one more notion before specifically addressing Figure 2. This is the concept of interdependence between social and technical components. Without making changes in the technology, we know that improvements in the social component often

result in improved performance. Without affecting the social component directly, we know that improvements in the technical system can lead to increased job satisfaction and a better quality of life at work. In other words, the two components are interdependent. In Figure 2, we use vectors to illustrate our best guess about the effect of the interdependent interaction of social and technical components. This interaction may result in a total movement that exceeds either of the individual components. Vectors are a means of representing the operational effect of joint social and technical movement.

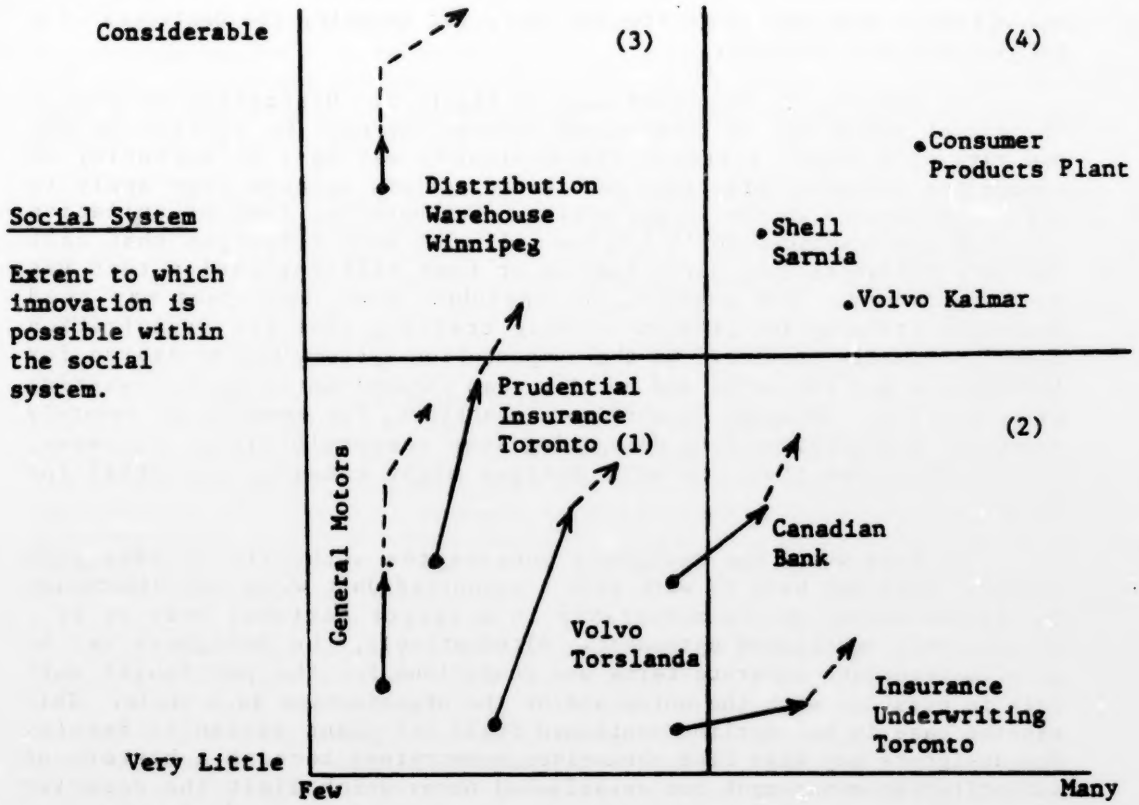


Figure 2. A Framework for Classifying Job and Organizational Innovations

Legend

→ - has occurred

⇢ - potential movement (short term)

Some Job Design and Sociotechnical Systems Examples

Cell 1 of Figure 2 represents situations where the freedom and discretion of the designers is significantly constrained. The automobile assembly line is the classic situation here. An existing assembly line has an extensive investment in its technology and its social system is considerably constrained by historical practices, group norms, strong unions, negotiated agreements, standardized labour practices and often, a history of poor labour-management relations. In spite of this classic categorization, some innovative management and labour leaders have discovered ways to improve the workplace.

At Volvo's older Torslanda plant, gradual change was the objective of a program to improve the workplace.[11] Four fronts for improvement were identified: (1) the physical environment, primarily of the workplace itself; (2) job design; (3) participation in committee structures; and (4) personal development, the chance for individuals to learn more and enhance their careers.

Torslanda began with job rotation in the upholstery department. Sore muscles led to the workers trading with each other to obtain relief. Production engineers in consultation with the workers gradually developed a system where each worker learned the task of all work stations and eventually rotated tasks every day or half-day. There was a sharp drop in aches and pains and fewer errors. In time, the upholsterers took over the department's planning functions and also the inspection of incoming materials. By 1973, 30 per cent of Volvo's 3 000 assembly people were rotating jobs.

In the United States, General Motors has begun to record a string of successes in redesigning work situations in plants where the assembly line technology is relatively fixed.[12] The range of activities undertaken are immense, but some guiding principles that underlie their efforts include: (1) the recognition that they are dealing with adults at all levels of the organization; (2) the use of participatory decisionmaking as a basic principle of management, for the benefit of the organization as well as the individual; and (3) an emphasis on flexibility in approach. In practice, this has frequently resulted in small areas working together as informal teams or sometimes as formally constituted business teams taking their own actions on problems. In an example taken from one informal team, the body-shop employees met in a series of "rap sessions" to find solutions for welding problems. Within several months the number of weld discrepancies was reduced from 35 per cent to 1½ per cent of all welds.

Both Volvo and General Motors are organizations working up the vertical axis of Figure 2. The more they can move in the direction of cell 4, either by increasing the discretion available to social system designers or by increasing the degrees of freedom along the technological axis, the greater the improvements in both the quality of working life and in performance will become. In existing automobile assembly lines most of the room to manoeuvre is along the vertical axis, but that can

still lead to significant performance improvements, because of the interaction effect social improvements have on how the work is done. Historically, technical changes were the norm in these industries. Social changes were rarely initiated. That has begun to change.

Cell 2 is an area where the system designers have considerable freedom to rearrange or reorganize the technical components but are restricted in what they can accomplish on the social side. A typical example here would be a white-collar operation such as the data processing section of an insurance organization. The system designers may be constrained by levels of skill and education of existing staff, meager traditions of collaborative work arrangements, company and industry wide norms, personnel practices and rewards systems, and long standing conservative attitudes to management and organization. Nevertheless, in selected units considerable progress has been made in redesigning the workplace. Some of this may have come about because of people's familiarity with technological change where, for example, successive generations of computer hardware have been introduced.

In one example, an underwriting group in an insurance company, the structure has been changed to assemble teams of underwriters and support staff who serve a particular geographical area. The team has been physically placed together and the different support personnel (control clerk, computer terminal operator, policy checker) have been cross-trained to cover for each other either in absences or under peak-loading conditions. As a team, they enjoy the satisfaction of seeing a client's case worked through all its stages and thus find the work less monotonous. Relatively few changes have been made to the reward systems or to promotion paths and this has served to limit the extent to which the team has been able to improve its functioning. Nevertheless there have been improvements which, for the most part, have resulted from a redesign of the relatively simple technical system.

A second example comes from redesign of the customer service counters of many branches of a major Canadian Bank. Entitled "the Central Teller System" and, for the public, "One Stop Banking", the system entails a technical redesign of the counter area so that there are ten to fifteen teller locations where there might have been three or four. Every teller now handles all customer requests, including opening new accounts, selling bonds, or conducting foreign exchange transactions - all activities previously handled by specialists. People who, in the past, were responsible for specialist functions now step up to a vacant teller position when the line-up of customers becomes too long. The tellers' task variety has increased significantly and pay systems are being designed to reward the tellers for the new skills acquired. All cash has been centralized in a central cage behind the counters. This has served to (1) cut down considerably on the cash reconciliation time at the end of the day, and (2) increase security since tellers maintain no cash supplies.

The bank system designers have not been able to obtain complete technical freedom. Most redesigns take place in branches where existing physical layout restricts the optimal arrangements between tellers and

the cage and the on-line computer terminals. However, the improvements have been significant enough to cause the bank to continue to change over branches to the Central Teller System at a rate of about six a month, with well over 100 such branches currently in operation.

In Cell 3 situations, the system designers have only limited control over the technical systems but considerably more control over the social systems. Many process technologies fall into this category. Where continuous flow and the need for particular stages to follow others in sequence characterize a technology, the designers must do what they can to organize the social system to accommodate many aspects of the technical design. However, they must always remember that it is the joint system, the social as well as the technical components, for which they must design.

An example of a Cell 3 situation is a consumer goods distribution center in Western Canada. The constraints on the designers included storage space in an existing structure, service to the stores and the ability to receive loads from suppliers. Desired improvements included in the design criteria were: smaller inventories which would permit distribution of more product lines (since only about 60 per cent of total potential was processed through the center); no second or evening shift, only an extended day shift; and one day service to the stores. The designers were also to allow for future use of on-site computers to process shipment requests. In this situation, the constraint on the designers is the simplicity of the technical system. The technology is straightforward and conventional. There is little that the designers can do to improve the system's functioning via the technological route. They must turn to the social system if they are to impact total system performance.

Cell 4 represents situations where the system designers have considerable freedom in the design of the technology and equal discretion in the design of the social system. This generally corresponds to new plant or organization designs but could also arise where the designers are given enough freedom over an existing arrangement that it effectively amounts to a new design situation.

One example from this cell is a major consumer goods manufacturer whose latest plant in Ontario has been designed as a completely new sociotechnical design. For example, the optimum technical solution indicated several long assembly lines. In fact, the assembly lines are short and curve back into each other in pairs. This allows operators to be physically adjacent to each other, to be able to talk, to hear each other (for even with sound-proofed equipment there's a high processing noise), to assist each other and to gain a sense of shared ownership over a small part of the production space. The teams are large enough to cover for all breaks, training time, meals, etc., and plan and schedule those activities themselves. They are assigned permanent team rooms from which they control their own operations and they allocate time to carry out that administration. Reward systems and a variety of support systems have been developed to be congruent with the team structure. Employees are hired through a complex interview process that screens them for their

collaborative skills. Even new professionals hired into the plant in managerial positions must spend a minimum of 18 months on the shop floor, to ensure that they never lose touch with a basic understanding of the shop floor task. This particular company has been designing plants to sociotechnical principles for over ten years and are reluctant to share that knowledge because they believe it gives them a competitive edge. They clearly believe it is worth doing.

Some Issues in Redesign

From our discussion of the examples in Figure 2, we can begin to respond to some of the questions raised earlier. Each design situation is unique. There is no obvious answer to the question of whether it is easier to design anew or to redesign. In the Shell Sarnia case, the design process ran relatively smoothly because the designers began early and were able to start from scratch. But refinery technology is complex and knowledge about the design of effective social systems is still immature. The sociotechnical system design process can take a long time and, in fact, did. In redesign situations there is a history of attitudes, behaviours and traditions that can seriously impede design changes. General Motors' successes are remarkable, but it is important to remember that they have only been achieved after many years of trial and error, with several failures along the way.

Even in organizations with considerable sociotechnical design experience, such as the Ontario consumer products plant, the process is a long one. The plant designers joined up with the manufacturing division as the basic plans for the plant were being developed, in this case several years before ground was broken at the new site. The same design team became the implementation team as the new plant experienced all the normal difficulties of start up. Only when the plant was operating smoothly did members of the team begin to disband and prepare for reassignment to the next plant. The duration of their involvement with a new plant's design and start up can range from a few years to as much as six or seven years. Clearly, however, the experience they carry forward to the next new plant design is invaluable to the organization.

In many redesigns, the initiators attempt to work with only a small portion of the existing system. If the technology is not too constraining, if the climate is reasonable, small redesign can be a lot "easier" than a new design. The question of whether new design or redesign is easier can't be answered without reference to the particular situation.

Many organizations have problems with an "experiment", particularly an experiment that takes a long time to prove itself. The experiment often gets special attention. This can invite jealousy. Other managers see it as a threat, and in the varying fortunes of many companies, the experiment can easily become a target of an austerity drive or the loser in a competition for scarce resources. The message for those who would experiment is that sanction from the top is vital. Every experiment encounters a period in its development when it needs protection from one or many of the possible misfortunes that can lead to its early termination.

Change is difficult. Mistrust between management and employees, uncertainty about outcomes, wary third parties, can all contribute to failed redesign efforts. One frequently offered piece of advice to those who would consider redesigning a work situation to improve the quality of working life is the suggestion that the initiator begin in at least two different areas at the same time. Failure has a high probability of occurring in job and sociotechnical system redesign. A failure when only one situation is involved will make it very difficult to build support for a second effort.

What comes first, performance improvement or quality of working life? For most researchers, consultants and observers of work design activity the answer is a universal one: both together. There are some who disagree. General Motors' claims quality of work life objectives as their unequivocal priority. They expect that performance will improve, but only as a by-product of the QWL interventions. In many instances, past history of employee and union mistrust of management would torpedo any intervention directed primarily at increasing production unless there were clear commitments to gain sharing (profit-sharing, Scanlon plans, worker ownership, etc.). Once again, it all depends. Nevertheless, some points must be made clear on this count. Successful job and socio-technical system design depends on employee commitment to the process. A production first policy provides very little incentive for obtaining that commitment. Clearly, QWL comes first. The only question is whether performance improvement is of equal priority, or whether it follows.

Who gains and who loses in a successful work redesign? The answer is straightforward. Most employees gain. Working conditions improve. The work itself improves. Grievances are reduced. Gain sharing may become part of the package of improvements. Management gains. Costly turnover and absenteeism are reduced. Quality usually improves. Productivity often does as well. Who loses? First-line supervision and sometimes middle-management and occasionally staff specialists, such as quality control and industrial engineers. As employees take on more responsibility and more administration, less of such activity is needed from specialists, foremen and supervisors. Sometimes there are new roles for them to learn. Sometimes their jobs are completely eliminated. We won't explore these issues here as they will be treated in a companion booklet.[13] However, it is evident that while some can adapt, others cannot. Some people, unquestionably, lose out in many job and sociotechnical system redesign efforts, and for the most part they are able to anticipate this outcome. If such situations are not well handled, they can quickly become the biggest stumbling-blocks to success. They have been in the past.

What are the unions' attitudes to these undertakings? They vary with the union and the location. The United Auto Workers in the U.S.A. have co-operated and continue to co-operate with General Motors Management, but they remain cautious. The Oil, Chemical and Atomic Workers have taken the initiative in many QWL undertakings and this is reflected in the Shell Sarnia agreement. At the Winnipeg distribution center, union and management and outside consultants have worked

together. At the Ontario consumer product plant there's a general belief that the sociotechnical designs have been implemented to forestall unionization. Yet in other parts of the same organization, redesigns are taking place in conjunction with unions. At Syncrude's giant plant in Alberta, the design philosophy has been based on sociotechnical principles; but unionization has been discouraged.

There's no clear cut answer. However, there are no fundamental differences between job design and sociotechnical systems and labour unions. In some instances there's a marriage. In others, a misfit. Again the message of situational uniqueness is reinforced.

Finally, sociotechnical designers must be conscious of the issue of diffusion from the very start. If the intervention is to diffuse beyond the trial site, if it is not to become "encapsulated" and totally separate from the rest of the organization, the designers must plan for that process early. Steering committees and representative groups at all levels must be kept informed of progress and be involved in decisions that might ultimately impact on their areas of work. As previously suggested, the designers should intervene on several fronts at once. Furthermore, the designs must take account of not only those who are prepared to experiment with new ways of working, but also those who want to continue to work as they have been working.

THE QUALITY OF WORKING LIFE

Creating an Organizational Culture

In an article summarizing ten years of study of innovative work arrangements, Dr. Richard Walton identified a three level conception of work improvement.[14] Figure 3 illustrates that conceptual scheme. Level I lists some of the design techniques available to the organization or system designers. It is similar, conceptually, to the combined "job characteristics" and "conditions of work" factors shown in Figure 1 of this booklet. Level II, work culture ideals, parallels the psychological states in that model. Finally, the business and quality of work life outcomes of Level III of Figure 3 are similar to the performance and job satisfaction outcomes, although some items are transposed.

Figure 3 is, in essence, a model of sociotechnical system, in the same way that Figure 1 is a model of job design. That there is an apparent convergence between the two models should not be surprising. Both approaches draw on the same behavioural science base (see Appendix 2). Both deal with the behaviour of people in work situations. The most significant aspect of their convergence is the common process both approaches follow. The intended outcomes of sociotechnical system designs can only be achieved by first developing a work group culture with some of the characteristics listed in Figure 3. Similarly, job design interventions can only succeed by developing a set of job characteristics that will lead to the appropriate psychological states. They, in turn, will lead to increased job satisfaction and performance improvements (Figure 1).

Some of the words that characterize the work culture ideals of Level II, namely, responsiveness, openness, mutual influence, trust, egalitarianism, equity, knowledge based influence, problem-solving and commitment, are not the words that usually accompany traditional ways of working. Rather, they give an important clue to the kinds of values that underlie new work organization designs. Those values must be reflected in the organizational policies and processes of job design and socio-technical systems innovation if the desired outcomes are to be achieved. A new organizational culture is the ultimate result of a commitment to a new set of values.

Figure 3. Three-level Conception of Work Improvement

Level I Design techniques	Level II Work culture ideals	Level III Intended results
Job design	High skill level and flexibility in using them	For business:
Pay	Identification with product, process, and total business viewpoint	Low cost
Supervisor's role	Problem-solving instead of finger pointing	Quick delivery
Training	Influence by information and expertise instead of by position	High-quality products
Performance feedback	Mutual influence	Low turnover
Goal setting	Openness	Low absenteeim
Communication	Responsiveness	Equipment utilization
Employment stability policies	Trust	For quality of work life:
Status symbols	Egalitarian climate	Self-esteem
Leadership patterns	Equity	Economic well-being
		Security

Author's Note: The design techniques, cultural ideals, and intended results listed above are presented as illustrative, not as comprehensive or even universally applicable. Also, the items in the three columns are not horizontally lined up to relate to each other.

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Job Design, Sociotechnical Systems and the Quality of Working Life

In a 1978 speech in Montreal, Ted Mills, the Director of the American Centre for the Quality of Work Life, described what is and is not a QWL approach. That speech was excerpted and rewritten into a booklet entitled "Quality of Work Life: What's in a Name?" by General Motors[15] who have since distributed it to tens of thousands of GM employees who participate in QWL programs.

Another very thorough outline of a strategy and process for conceiving and implementing a QWL program, particularly in a unionized environment, can be found in Labour Canada's booklet entitled "QWL: The Idea and its Application".[16] Both booklets stress characteristics of QWL that are fundamental to job design and sociotechnical systems.

QWL activities should be seen in operational terms, as a function of the line organization responsible for producing the product. Its not something to be managed by the Human Resources department. It belongs to those who will benefit from its implementation. QWL involves commitment from those involved, including unions if unions are part of the situation. QWL design activities tap existing expertise. It's not that outside expertise isn't utilized, its just that the wealth of knowledge of those involved in the job is brought to bear in an organized manner.

QWL usually means designing new work structures to make things happen. Such work structures are task oriented, often involve many levels in the organization and are generally composed of people with different functional skills. Many of the structural arrangements are informal, in other words, they don't show up on organization charts, but are composed of committees and teams of people in configurations needed to get the job done. Generally the structural arrangements aim to spread out and involve more and more people in the process, both to build support for the structure and to avoid "we-they" distinctions between those who are "in" and those who are "out". QWL designs need sanctioning from those with authority and control over resources. If not, too many of the improvements can be blocked and impede further functioning of the new arrangements.

QWL activities may be separate from, or part and parcel of, the collective bargaining process depending on the views of the parties. In any event, it is critically important that QWL not be used to undermine the basic protections built into negotiated collective agreements. QWL means training in problem-solving. Team and individuals must have some of the basic skills to solve problems and improve workplace functioning. QWL requires commitment to the workforce, the kind of insurance needed to overcome the uncertainties associated with start up, with the critical

moment when new ways of working are being implemented. Finally, QWL means measurement of progress. Data must be collected to assess progress and to provide a basis for making changes when they become necessary.

CONCLUSIONS

Organizations, because of their unique combination of goals, people, history and culture, are themselves unique. While we have presented models for job design and sociotechnical systems, these models are of a very general nature. They offer guidance on some aspects to consider in work design and on the sequence of change: from structural interventions (job characteristics and design techniques) through behavioural change (psychological states and work culture ideals) to outcomes (performance and business results and job satisfaction and an improved quality of working life). However, they do not offer a ready-made formula. The uniqueness of each organization demands that the models be adapted to fit that organization's goals and values, the desires of that particular set of people, their stage of organizational development and the type of organizational culture they can and wish to live in.

In the early paragraphs of this booklet, job design and socio-technical systems were identified as sub-sets of the issues commonly recognized as quality of working life issues. As such, generalizations that hold true for QWL apply to job design and sociotechnical system design as well. Hence, Walton's imperative, that we must influence the culture of the system if we are to change the outcomes, applies to all job design and sociotechnical system situations. So, too, do the QWL approaches advanced by General Motors and Labour Canada.

General Motors' booklet ("Quality of Work Life: What's in a Name?") and Labour Canada's booklet ("QWL: The Idea and its Application") both point to an important conclusion about QWL in general and job design and sociotechnical systems in particular. Redesigning work is a broad, not a narrow, undertaking. The approach to change must be holistic. It must engage the total unit or system being considered and all the interactions of that unit or system with its larger environment. It is a significant task to change to a new paradigm of work. It is also a long and a difficult task. However, in the words of an old Chinese proverb, "A journey of a thousand miles begins with a single step."

APPENDIX 1

Some Ways in Which Tasks may be More Effectively put Together to Make Jobs[17]

(a) Optimum variety of tasks within the job. Too much variety can be inefficient for training and production as well as frustrating for the worker. However, too little can be conducive to boredom or fatigue. The optimum amount would be that which allows the operator to take a rest from the high level of attention or effort in a demanding activity while working at another and, conversely, allows him to stretch himself and his capacities after a period of routine activity.

(b) A meaningful pattern of tasks that gives to each job the semblance of a single overall task. The tasks should be such that, although involving different levels of attention, degrees of effort, or kinds of skill, they are interdependent. That is, carrying out one task makes it easier to get on with the next or gives a better end-result to the overall task. Given such a pattern, the worker can help to find a method of working suitable to his requirements and can more easily relate his job to those of others.

(c) Optimum length of work cycle. Too short a cycle means too much finishing and starting; too long a cycle makes it difficult to build up a rhythm of work.

(d) Some scope for setting standards of quantity and quality of production and a suitable feedback of knowledge of results. Minimum standards generally have to be set by management to determine whether a worker is sufficiently trained, skilled, or careful to hold the job. Workers are more likely to accept responsibility for higher standards if they have some freedom in setting them and are more likely to learn from the job if there is feedback. They can neither effectively set standards nor learn if there is not a quick enough feedback of knowledge of results.

(e) The inclusion in the job of some of the auxiliary and preparatory tasks. The worker cannot and will not accept responsibility for matters outside his control. In so far as the preceding criteria are met, then the inclusion of such "boundary tasks" will extend the scope of the worker's responsibility for and involvement in the job.

(f) The tasks included in the job should entail some degree of care, skill, knowledge, or effort that is worthy of respect in the community.

(g) The job should make some perceivable contribution to the utility of the product for the consumer.

(h) Provision for "interlocking" tasks, job rotation, or physical proximity where there is a necessary interdependence of jobs. At a minimum this helps to sustain communication and to create mutual

understanding between workers whose tasks are interdependent, and thus lessens friction, recriminations, and "scapegoating". At best this procedure will help to create work groups that enforce standards of co-operation and mutual help.

(i) Provision for interlocking tasks, job rotation, or physical proximity where the individual jobs entail a relatively high degree of stress.

(j) Provision for interlocking tasks, job rotation, or physical proximity where the individual jobs do not make an obvious perceivable contribution to the utility of the end-product.

(k) Where a number of jobs are linked together by interlocking tasks or job rotation they should as a group:

(i) have some semblance of an overall task which makes a contribution to the utility of the product;

(ii) have some scope for setting standards and receiving knowledge of result;

(iii) have some control over the "boundary tasks".

(l) Provision of channels of communication so that the minimum requirements of the workers can be fed into the design of new jobs at a early stage.

(m) Provisions of channels of promotion to foreman rank, which are sanctioned by the workers.

The above hypotheses are merely intended as an illustration of the sorts of matters we would wish to keep in mind in studying the chosen factories.

It will be noted that these hypotheses are concerned with a limited number of general psychological requirements:

(1) the need for the content of a job to be reasonably demanding of the worker in terms other than sheer endurance, and yet to provide a minimum of variety (not necessarily novelty);

(2) the need for being able to learn on the job and to go on learning; again it is a question of neither too much nor too little;

(3) the need for some minimal area of decisionmaking that the individual can call his own;

(4) the need for some minimal degree of social support and recognition in the workplace;

(5) the need for the individual to be able to relate what he does and what he produces to his social life;

(6) the need to feel that the job leads to some sort of desirable future.

These requirements are not confined to operators on the factory floor, nor is it possible to meet them in the same way in all work settings or for all kinds of people.

APPENDIX 2

The Genealogy of Work Design

In the late 1890's and early 1900's, Frederick Taylor, an early industrial engineer, engaged in a variety of innovative experiments in the design of jobs that to this day remain basic to how people work in organizations. Taylor's experimentation and findings were summarized in a school of thought (called Scientific Management) that was the forerunner of many of our current approaches to the design of jobs, particularly assembly line operations. It remains today the basis for the design of work in a wide variety of organizations. One of Taylor's famous prescriptions was that of fitting the man to the job. He suggested that if we wanted a first class job properly done, then it was incumbent upon us to find a first class man to do it. It followed that a second class job merited a second class man and so on.

In their own way the behavioural sciences attempted to follow the pattern laid down by Scientific Management. The 1940's and the 1950's were the heyday of the industrial psychologists who believed that people could be selected to fit the needs of particular jobs. They might be selected according to psychological attributes, say attitudes, or by their physical attributes, for example, manual dexterity. Unfortunately, the industrial psychologists were not too successful at selecting people because the tools for selection were not available or were not reliable enough. In the 1950's and the 1960's this led to the notion that if people could not be selected to fit the job then they might be trained to do so. This was the period when human relations training was popular and T-groups and sensitivity training were used within organizations. Many foremen and first line supervisors were sent to training seminars to learn to become more humanistically oriented toward their subordinates. In some cases there were behavioural changes, but often they were short-lived, primarily because the organization remained the same and did not reward the new behaviour.

In the 1960's and 1970's the behavioural sciences adopted a new perspective. If people could not be selected to fit the jobs, and if they could not be trained to match the jobs, then perhaps it was possible to rearrange the jobs to fit the people. We entered the era of job and organization design. What we have learned about jobs and people suggests that the design and redesign of jobs and organizations to better accommodate the people who work in them might be the best way for us to improve both the quality of life at work and organizational effectiveness.

Louis Davis and James Taylor have proposed a "Genealogy of Work Design" that speaks specifically to the title of this booklet.[18] They suggest that work design, as we now understand it, can be divided into four distinct categories based on different intellectual and research traditions. The first two have been identified in the preceding paragraphs.

1. Task and Job Rationalization builds from the basic factory system of the industrial revolution. It has evolved through Taylor's Scientific Management school and time and motion studies to more recent work simplification perspectives. It also draws on human engineering studies as well as some experimental and industrial psychology. This category of work design has tended to be the domain of work methods specialists and traditional industrial engineering.

2. Job Content builds from several bases, including the findings of the human relations school. It includes the concepts of job satisfaction, job enlargement and the job enrichment theories of Frederick Herzberg. It also expresses some concern for the different social and cultural variables that lead to different values and beliefs in members of the workforce. This is the tradition that best represents the relatively recent (and quite humanistic) job enrichment approaches to work design.

3. Role Content builds from the social-psychological and psychoanalytically based traditions of "group dynamics". It includes the job design and organizational unit design perspectives of Louis Davis and Fred Emery and the sociotechnical systems concepts of Emery and Eric Trist. It builds on the early textile mills and chemical industry field studies of A.K. Rice in India and the recent experiments in democratization of the workplace in Norway (Thorsrud and Emery). We will take the liberty of expanding this category to include the recent job characteristics models of Hackman and Oldham as well as Richard Walton's descriptions of work innovations in the United States. This is the particular tradition that underlies the title of this booklet.

4. Organizational Units is based on open systems theories (von Bertalanffy) and the concept of purposeful systems (Ackoff and Emery). It uses goal directed notions (Sommerhoff) to advance concepts of smaller, self-maintaining organizational units. This tradition is reflected in several recent and radically different new plant designs.

FOOTNOTES

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2. Figure 1 is derived from the model of job design advanced by J.R. Hackman and G.R. Oldham ("Motivation through the Design of Work: Test of a Theory", Organizational Behaviour and Human Performance, 16(2), 1976, pp. 250-279). The conditions of work addition is similar to the "extrinsic factors" of Frederick Herzberg (Work and the Nature of Man, Harcourt, Brace and World, 1966). The physical state adds some blue-collar concerns to these essentially white-collar situation models.

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6. The material describing this example is extracted from J. Mansell, R. Wilkinson and A. Musgrave, An Inventory of Innovative Work Arrangements in Ontario, Research Branch, Ontario Ministry of Labour, September 1978, pp. 77-80 and Linda Rosenbaum and Barbara Dresner, "Is Job Boredom Really Necessary?", Canadian Business, June, 1979, pp. 66-71.

7. The material in this section is extracted from several sources: E.L. Trist and K.W. Bamforth, "Some Social and Psychological Consequences of the Longwall Method of Coal Getting," Human Relations, 4, 1951, pp. 3-38; E.L. Trist, G.W. Higgin, H. Murray, and A.B. Pollock, Organizational Choice, Tavistock, 1963; F.E. Emery and E.L. Trist, "Sociotechnical Systems" in C.W. Churchman and M. Verhulst, Eds., Management Science Models and Techniques, V2, Pergamon Press, 1960.

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